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City of Fort Collins
Engineering

Transportation Capital Project Prioritization Study

Fort Collins, Colorado

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1. PURPOSE & BACKGROUND

The City of Fort Collins selected Olsson to complete the Transportation Capital Project Prioritization Study (TCPPS). This study focused on arterial roadway and intersection improvements based on selected criteria that balances the need for safety and congestion improvements with the priorities of the community.

1.1 Study Background & Purpose

The City of Fort Collins conducted an Arterial Intersection Prioritization Study (AIPS) in 2010 and updated the study in 2016. The results of these efforts guided the selection of intersection improvement projects for pursuing grant funding, design, and construction. Most of the highest priority projects from the AIPS have been completed. This current study seeks to provide the next round of project identification and prioritization to guide capital project investment over the near-term planning horizon.

The City's Community Capital Improvement Program (CCIP) sales tax includes dedicated funding for arterial intersection improvements. There are additional funding sources available for corridor improvements within City limits and within the GMA. These funds are often used to leverage Federal and State grants. Additionally, the City's Budgeting for Outcomes (BFO) budget process has historically been used to help fund large transportation capital projects.

This Transportation Capital Project Prioritization Study (TCPPS) was initiated by the City of Fort Collins to identify arterial roadway and intersection improvements both within the City limits, and within the Growth Management Area (GMA). The analysis summarized in this report includes a compilation of data for arterial intersections and corridors, assessment of existing conditions for various quantitative and qualitative considerations, identification of potential improvement projects to address transportation system deficiencies, and prioritization of project needs based on feedback from the community.

This study represents a broad evaluation of arterial roadway and intersection needs within the City and GMA and includes criteria that overlap with other City efforts, such as multimodal (bicycle, pedestrian, and transit) considerations. This study is supplemental to other key citywide efforts focused specifically on these priorities, such as the Fort Collins Bicycle Master Plan (2014), Fort Collins Pedestrian Plan (2011), Fort Collins Transit Master Plan (2019), Active Modes Plan (On-Going). It is not the intent of this study to replicate or supersede the recommendations of these studies, but to supplement and/or implement the guidance of these efforts at the arterial intersection and roadway level.

1.2 Study Framework

This study represents a three-phase, data-driven approach to project identification and prioritization. Phase 1 consists of a high-level screening evaluation of arterial intersections and arterial corridors based on key factors of safety and capacity. These locations are analyzed based on the potential to improve safety and congestion through improvements such as intersection geometric and roadway construction, signal timing adjustments, signal modifications or replacements, re-striping, or other treatments.

The top ranked locations for potential improvements were identified and specific project improvements were developed at these locations. These projects were then evaluated and prioritized in Phase 2 based on quantitative criteria and qualitative criteria. The criteria were established in coordination with City staff and aligned with the Active Modes Plan (AMP). Each project was then scored and ranked based on the priorities of the City. This phase resulted in a prioritized list of top-tier projects that were carried forward Phase 3.

Table 1 – TCPPS and Active Modes Alignment

	TCPPS	Active Modes Plan
Quantitative Criteria	**Crash Reduction** Reduction in annual crashes (crashes/year)	**Safety & Comfort** Citywide High-Injury Network; Bicycle or Pedestrian Level of Traffic Stress; Pedestrian distance to low-stress crossing opportunities
	Peak Hour Delay Reduction Amount of delay reduction (seconds)	**Access** Number of nearby Transfort stations or stops
	Equity Fort Collins Health Equity Index (unitless)	**Health & Equity** Fort Collins Health Equity Index
	Growth Expected traffic growth from NFRMPO (%)	**Network Connectivity** Number of connections to existing or proposed bicycle/trail network
Qualitative Criteria	**Cost** Estimated project cost	**Cost** Estimated project cost
	Readiness Availability of funding, railroad or utility impacts, right of way impacts and environmental impacts	**Readiness** Additional study or analysis needed
	Multimodal Benefit Supports proposed bike/ped/frequent transit projects	**Multimodal Benefit** Coincides with proposed bike/ped/frequent transit projects
	Synergy Supports other currently funded or programmed public or private projects	**Synergy** Addresses the potential to support other currently funded or programmed public or private projects
	Community Addresses community needs and interests based on public input and identified community activity centers, open spaces, etc.	No comparable metric

Phase 3 takes the top-tier projects and further defines each project's specific improvements and cost. Conceptual designs will be prepared that show the recommended improvement, impacts, and conceptual cost estimate. This information will be used by the City to aid in preparing the Ten-Year Transportation Improvement Plan and identifying funding opportunities.

1.3 Public Involvement

The local community and stakeholders were engaged throughout the entire study to gain an understanding of the issues and challenges facing the transportation network in Fort Collins. Input from the overall effort was used to not only identify location where improvements were needed but to also understand the desires of the public to inform creation and weighting of the prioritization criteria. A public involvement strategy consisting of a series of online and in person engagement opportunities, including the following outlets, was conducted:

- Webpage
- Social Media
- Press Releases
- Newsletters
- Community Partners Email Blasts
- In Person & Virtual Open Houses
- Public Surveys
- Transportation Board Presentations

The complete public involvement plan and engagement results can be found in **Appendix A – Public Engagement Summary**. The information gathered was incorporated into each phase of the study and used to guide the study, to ensure that the detailed engineering results produced aligned with the real-world observations and needs of the community.

1.4 GIS Tools

Concurrent to the TCPPS, Olsson developed two GIS-based tools to assist the City of Fort Collins in a data-driven approach to maintaining the capital projects list. These include a Screening Tool that houses the city-wide congestion and safety data as well as other relevant data, and a Management Tool that houses the project list with associated tags and filters. In future years, these tools can be updated with new information, such as that related to congestion and safety. As the City continues to grow and develop, projects can be reprioritized as needs shift and funding becomes available. This section provides a description of these tools. Additionally, user guides for each tool are included in **Appendix B.**

1.4.1. Screening Tool

The screening tool was created with the intent of housing all the information needed to conduct the Phase 1 effort of this study. It contains GIS layers showing current and notable features within Fort Collins. The Screening Tool is an online GIS Web Application that can be found here: Fort Collins TCPPS Phase I Screening Tool (arcgis.com). This tool contains the data layers that were used in TCPPS to identify top locations that would benefit from improvements, shown in **Table 2**.

Table 2 – Screening Tool Layers

Congestion	
AM LOS	PM LOS
Midday LOS	
Safety	
LOSS	Excess Crash Cost
Excess Crash Costs Trends	
Active Modes	
Master Street Plan	Multi Use Trail
Bus Routes	Planned Trail
Bicycle Network	Pedestrian Priority Areas
Public Engagement Results (by mode)	
Driving Issues	Biking Issues
Walking Issues	Transit Issues
Community	
Poudre School District - Schools	Elementary School Attendance Zones
Community Activity Center	Middle School Attendance Zones
Hospitals	High School Attendance Zones
Structure Plan – Land Use	
Planning Area	
Adjacent Planning Areas	Fort Collins City Limits
Fort Collins Growth Management Area	
Equity	
Health Equity Index	

Each of these data layers can be updated in future years to identify new potential projects. Instructions for updating this Additional information regarding the Screening Tool can be found in **Appendix B – GIS Users Manual.**

1.4.2. Management Tool

Like the Screening Tool, the Management Tool was created to support the study process as the City of Fort Collins shepherds the capital projects list moving forward. This tool is a dashboard-based application that is built around the dataset that includes all the capital and operational projects and corridor studies identified in TCPPS. Each project features the associated information to assist with sorting and filtering projects as shown in **Table 3**.

Table 3 – Management Tool Filters

Field	Description
Project ID	Formatted as: Year Created – 001 (autoincremented, e.g. 22-001)
Project Name	Name of the project
Project Type	Intersection Improvements, Corridor Improvements, Road Diet, New Construction
Project Category	Capital, Corridor Study, Operational
Project Description	A brief narrative of the proposed improvements
Notes	Information about status, related projects, or other considerations
Project Status	Active, Inactive, Programmed
Quantitative Criteria Scores & Weighting	Crash Reduction, Delay Reduction, Health Equity, Traffic Growth
Qualitative Criteria Scores & Weighting	Readiness, Cost, Multimodal Benefit, Synergy, Community (Benefit)

In addition to the data associated with the projects, each polygon that represents a project will have an informational sheet (in PDF format) attached to it that summarizes the essential information like scope, budget, anticipated schedule, anticipated impacts, potential funding sources, and an image of the conceptual design.

The tool features an input function that allows users to manipulate the data set by adding or modifying projects without requiring direct access to the data. This input function allows the management tool to remain dynamic and functional into the future as existing projects are completed and projects are either moved up in priority or added to the list.

Through the development of the management tool, the City realized potential benefit to organizing project selection across multiple departments. The tool developed in this study was determined to be the beta version and will continue to be developed in future task orders to benefit the wider Fort Collins departments with prioritization.

2. PHASE 1 – ANALYSIS & SCREENING

The project study area and intersections included in this analysis are shown on **Figure 1**. The intersections chosen for the study include signalized arterial intersections, unsignalized arterial/arterial intersections and arterial segments. An initial, high-level screening of arterial intersections and corridors was conducted based on a data-driven evaluation of safety and congestion conditions within the City and GMA. The following safety and congestion sections describe the methodology utilized for both categories.

To accurately plan within the context of future conditions of the TCPPS study area, the new and proposed streets which are part of known significant and upcoming developments were also included in the screening. The largest development in the planning horizon is the Montava Master Planned Community. Montava is an 860acre mixed use master planned community located in northeast Fort Collins on agricultural land adjacent to the Anheuser-Busch facility.

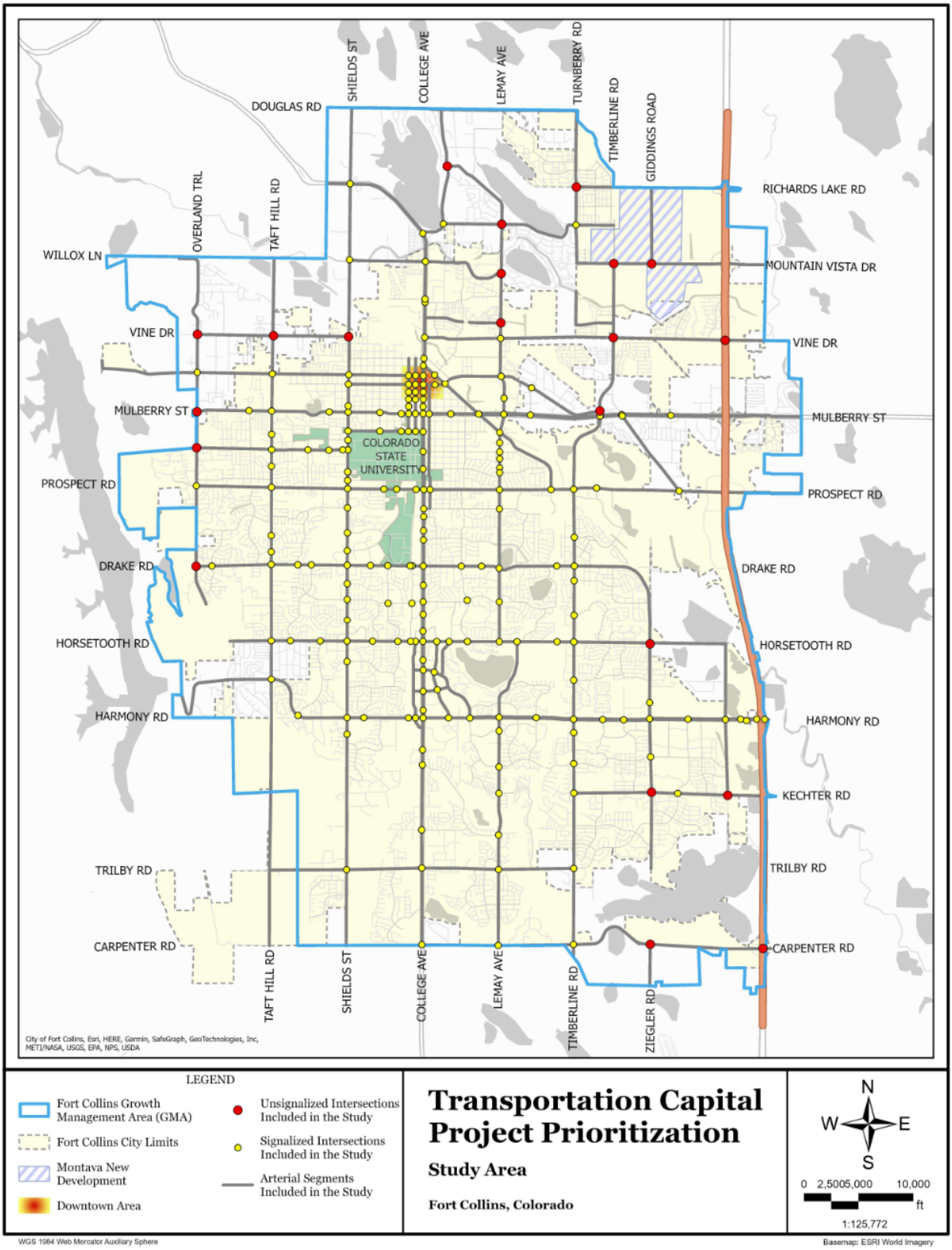

Figure 1 – Study Area

2.1 Screening Analysis

2.1.1. Intersection Congestion

Intersection capacity was evaluated for all signalized intersections using the Highway Capacity Manual (HCM) delay methodology (with Synchro capacity modeling software) for existing AM, mid-day, and PM weekday peak hours. HCM delay is represented in average delay per second for individual movements (turns), intersection approaches, and for each overall signalized intersection. A "Level of Service" (LOS) letter grade A through F is assigned to the average delay values with LOS A representing near free flow conditions, and LOS F representing congested conditions shown in **Table 4**. Typically, LOS D or better is considered acceptable at an arterial intersection during peak hour conditions.

Table 4 – Level of Service Criteria

Level-of-Service	Average Control Delay (seconds)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50

Source: Highway Capacity Manual (HCM 6th Ed.)

Table 4-2 of the LCUASS defines LOS standards for Fort Collins, outlining various LOS thresholds required to satisfy Adequate Community Facilities (ACF) standards for signalized and unsignalized intersections. This standard requires signalized arterial intersections to operate at LOS D or better overall and LOS E or better for any leg or movement. Unsignalized arterial intersections must operate at LOS E or better (LOS D in some cases) and may operate LOS for any leg or movement. Roundabouts must operate at LOS E for any movement, leg, and overall. These standards were used to guide determinations of when an intersection is considered to operate at an unacceptable level.

2.1.2. Intersection Crashes

The safety analysis performed for the TCPPS study area included an intersection-by-intersection review of excess crash costs, the intersection Level of Safety Service (LOSS), and excess crash cost trends. Crash data was provided by the City of Fort Collins. The results of the excess crash cost and LOSS analysis was also provided by way of *Fort Collins Annual Roadway Safety Review* (City of Fort Collins 2021). This memorandum summarizes a statistical analysis of crashes at intersections; examining the crash frequency, patterns, and severity.

Excess Crash Costs

Three years of crash data from 2018 to 2020 throughout the study area were quantified by the City in terms of potential crash reductions by using the excess crash costs methodology from the American Association of State Highway Transportation Officials (AASHTO) Highway Safety Manual (HSM). This methodology compares the actual crashes accounted for at each intersection in the crash history dataset with the number of crashes predicted to likely occur within the model, based on general information such as roadway type, intersection control, and annual average daily traffic (AADT). This methodology standardizes the estimation of the economic and societal costs of crashes in a consistent and reliable way to highlight intersections that are quantitatively performing poorer than expected in terms of safety. This data can be used to determine the intersections with the most potential for crash reduction and to provide preliminary insight into crash patterns and potential issues at intersections.

Level of Safety Service (LOSS)

The LOSS is a methodology pioneered by the Colorado Department of Transportation (CDOT) to identify locations with potential for safety improvements. The LOSS uses quantitative methods to compare crash frequencies and severities against Safety Performance Functions (SPFs) and is the reported with qualitative descriptors to characterize the potential crash reduction of a roadway. The LOSS is categorized between LOSS 1 to LOSS 4 in which LOSS 4 has the highest potential for crash reduction and improved safety. While similar in function to the excess crash cost methodology, the LOSS methodology is specifically calibrated to Colorado's public roadways.

Excess Crash Cost Trends

The excess crash cost trends compare excess crash costs of the 2018 through 2020 dataset with an additional three-year dataset from the years 2015 to 2017 to determine whether the safety of each intersection is trending in a positive or negative direction. The TCPPS methodology prioritizes addressing intersections with a negative trajectory as these have the highest potential for safety improvements.

After these metrics were assessed across the TCPPS study area, City of Fort Collins staff and TCPPS project staff excluded intersections from the rankings which were either trending positively, having no excess crash costs, intersections which have been improved recently or are currently undergoing construction, and intersections which are to be included in larger corridor projects.

2.2 Screening Results

The results of the Phase 1 congestion and safety screening for the top intersections and corridors are described in detail below. In each table, the locations have been sorted by performance in descending order, with intersections or corridors that have the worst delay and safety ratings at the top, and those with the more acceptable delay and safety ratings at the bottom.

2.2.1. Intersection Congestion Screening

The top twenty congested arterial intersections based on the average overall delay (per second) are shown in **Table 5**. These intersections have unacceptable overall LOS as described in LCUASS which follow the delay standards put forth in the ACF. As these are all signalized intersections, the list reflects locations with overall intersection delay greater than 55 seconds (LOS E) at any peak hour or individual approaches greater than 80 seconds (LOS F) for any peak hour. Those with both overall intersection and approach delay that exceed ACF standards are considered strong candidates to include in projects for Phase 2.

Table 5 – Top Twenty Congested Intersections

Intersection	Overall Intersection			Worst Approach		
	Delay (sec)	LOS	Peak Hour	Delay (sec)	LOS	Peak Hour / Approach
Timberline & Willow Springs/Kechter	261.7	F	Midday	566	F	Midday / West
McClelland/Max BRT & Drake	200.1	F	PM	315	F	PM / East
Taft & Mulberry	184.8	F	Midday	360	F	Midday / West
College (US 287) & Harmony	65.8	E	PM	90	F	PM / North
Shields & Elizabeth/Moby Lot (Eliz)	62.4	E	PM	97	F	PM / East
College (US 287) & Drake	60.3	E	PM	97	F	Midday / East
College (US 287) & Trilby	58.7	E	PM	82	F	Midday / East
Lemay & Drake	56.9	E	PM	95	F	PM / East
Shields & Prospect	53.2	D	PM	109	F	PM / West
Timberline & Harmony	53	D	PM	99	F	PM / South
Timberline & Mulberry	47.8	D	PM	102	F	AM / North
Timberline & Drake	46.9	D	PM	90	F	AM / West
Lemay & Harmony	42.5	D	PM	84	F	PM / South
Lemay & Riverside	40.7	D	PM	92	F	PM / North
Taft & Harmony	40	D	PM	83	F	AM / North
Hogan/JFK & Harmony	37.5	D	PM	102	F	PM / South
Riverside & Prospect	34.2	C	PM	94	F	PM / South
Shields & Raintree/Centre	31.1	C	PM	151	F	AM / West
Link Lane & Mulberry (State 14)	28.7	C	PM	114	F	PM / North
Shields & Swallow	24	C	PM	88	F	PM / West

2.2.2. Safety Screening

Intersection Safety Screening

Table 6 provides the top intersections with the highest potential for safety mitigation determined by the City of Fort Collins in the *Roadway Safety in the City 2019 Annual Report*. These intersections are ranked by excess expected crash costs as described in **Section 2.1.2**. The top 25 locations were reported as these were identified in Annual Crash Report is the highest priority locations. Intersections that have both excess and increasing crash costs and LOSS 4 were given high priority to move to projects in Phase 2.

Table 6 – Top Twenty-Five Intersection Safety Rankings

North-South Street	East-West Street	Excess Expected Crash Value ($)	LOSS Total Crashes	LOSS Fatality / Injury Crashes	Δ Crash Cost (1)
College Ave	Trilby Rd	$673,877	LOSS 4	LOSS 4	-$24,614
Boardwalk Dr	Harmony Rd	$524,469	LOSS 4	LOSS 4	$412,317
College Av	Harmony Rd	$456,046	LOSS 3	LOSS 3	$546,967
Shields St	Horsetooth Rd	$326,204	LOSS 3	LOSS 3	$386,382
College Av	Mulberry St	$309,376	LOSS 4	LOSS 3	$449,517
College Av	Vine	$293,951	LOSS 3	LOSS 4	$116,369
Timberline Rd	Custer	$191,575	LOSS 4	LOSS 4	$184,565
Shields St	Trilby Rd	$177,210	LOSS 4	LOSS 4	$122,793
Shields St	Plum	$169,343	LOSS 3	LOSS 3	$45,670
Mcclelland	Horsetooth	$163,920	LOSS 4	LOSS 4	$54,859
Remington	Mulberry St	$158,113	LOSS 3	LOSS 4	-$43,039
Taft Hill Rd	Mulberry St	$150,931	LOSS 3	LOSS 3	$93,264
Shields St	Harmony Rd	$142,966	LOSS 3	LOSS 3	$67,677
College Av	Willox	$130,010	LOSS 3	LOSS 3	$247,018
Taft Hill Rd	Prospect Rd	$127,015	LOSS 3	LOSS 3	$20,452
Lemay	Horsetooth (East)	$115,523	LOSS 3	LOSS 3	$121,127
Heatheridge	Prospect	$104,694	LOSS 4	LOSS 4	$122,097
Lemay	Carpenter	$101,682	LOSS 3	LOSS 3	$102,539
JFK	Boardwalk	$100,645	LOSS 3	LOSS 4	$119,628
College Av	Kensington	$99,672	LOSS 3	LOSS 3	-$14,934
Mason	Mulberry	$79,567	LOSS 3	LOSS 3	-$6,684
Taft Hill	Clearview	$78,218	LOSS 3	LOSS 4	-$28,289
Stover (East Int.)	Prospect	$75,178	LOSS 4	LOSS 4	$45,860
College Av	Cherry	$72,914	LOSS 3	LOSS 3	$86,460
Overland	Elizabeth	$63,090	LOSS 3	LOSS 3	$101,346

(1) Crash trends comparing 2015 - 2017 vs. 2018 – 2020 as the difference in crash cost

Corridor Safety Candidates

Table 7 provides a summary of crash rates along roadway segments for crashes that were not assigned to intersections. These include mid-block crashes related to turning movements and crashes that occurred at driveway access points, in addition to other non-intersection related crashes. A higher ranking indicates a higher crash rate. Crash rates are expressed as crashes per million entering vehicles (MEV) in order to normalize the crash data with roadway volumes and segment lengths. This data was assessed in conjunction with the arterial intersection safety and congestion analysis to identify potential projects that may overlap between the two data sets (intersection and roadway segment). Roadway segments that had either a discernable crash pattern or could be included with other intersection or corridor projects were identified as strong candidates to include in projects to move into Phase 2.

Table 7 – Top 25 Roadway Segment Crash Rankings

Rank	Roadway Segment	Segment ID(s)	Extents	Crash Rate
1	W. Mountain Ave.	6932, 6934	Howes to College	1306.0
2	Jefferson St.	6271, 6272	College to Mountain	1068.7
3	E. Mountain Ave.	6574	Matthews to Riverside	916.3
4	N. College Ave.	3707, 5408	Mountain to Jefferson	874.8
5	S. College Ave.	47, 48	Olive to Mountain	738.8
6	E. Troutman Pkwy.	1424	College to JKF	732.1
7	W. Troutman Pkwy.	3724	Mason to College	707.1
8	Boardwalk Dr.	5519	College to Whalers Way	651.7
9	S. Taft Hill Rd.	5508	Trilby to Brixton	449.3
10	W. Elizabeth St.	2673	Hillcrest to S. Taft	433.4
11	S. Mason St.	1427, 598	Boardwalk to Horsetooth	423.2
12	W. Elizabeth St.	1882, 2647	Constitution to Shields	397.9
13	S. Mason St.	4118	Harmony to College	390.6
14	N. College Ave.	5410	Vine to Suniga	370.5
15	S. College Ave.	3385, 3387	Laurel to Mulberry	368.8
16	W. Prospect Rd.	4158	Center to Bay	351.1
17	W. Drake Rd.	700375823, 2945	Meadowlark to College	306.9
18	E. Willox Ln.	935	College to Blue Spruce	286.3
19	S. Taft Hill Rd.	5491	Drake to Valley Forge	284.7
20	S. College Ave.	2939, 2940, 2950, 2958, 2959, 4571, 5516, 5517, 5518	Prospect to Drake	218.1
21	E. Prospect Rd.	6239	Lemay to Yount	256.0
22	S. Lemay Ave.	7902	Prospect to Stuart	245.2
23	E Harmony Rd.	5532	Timberline to Snow Mesa	229.7
24	S. College Ave.	1412	Horsetooth to Bockman	226.5
25	N. Lemay Ave	4308	Lincoln to Buckingham	209.7

2.2.3. Road Diet Screening

Road diets are frequently considered when a corridor has excess capacity and a high frequency of crashes, high incidence of speeding or would benefit from additional multimodal facilities. Such preliminary planning-level analyses have been performed for this project to identify potential road diet candidates along arterial corridor segments within the study area.

The corridor segment capacity analysis used the latest traffic count data, along with 2040 growth rates, from the North Front Range Metropolitan Planning Organization (NFRMPO) travel demand model. These volumes were compared against assumed traffic volume thresholds shown in **Table 8 and 9.** Volume thresholds are defined as the maximum traffic volume at a roadway's ultimate capacity – assumed to be LOS E. Volume thresholds vary for different roadway types based on multiple geometric and operational factors, including roadway surface, number of lanes, lane width, presence of turn lanes, and access condition..

Table 8 – Two Way Urban Arterial Street Segment Capacities

Total Number Of Through Lanes	Median Type	Turn Lanes	Access Condition			
			Minimal	Light (Residential)	Moderate (Mixed Zoning)	Heavy
2	Undivided	Gravel	2,000	-	-	-
		Without Left Turn Lanes	13,400	12,800	12,400	11,600
		With Left Turn Lanes	15,600	15,000	14,000	13,600
2	Divided	Without Left Turn Lanes	14,400	13,800	13,400	12,600
		With Left Turn Lanes	17,800	17,000	15,600	15,400
3	TWLTL	With Left Turn Lanes	17,600	17,000	15,400	15,400
4	Undivided	Without Left Turn Lanes	27,000	26,000	26,000	24,400
		With Left Turn Lanes	33,600	32,400	32,200	30,200
5	TWLTL	With Left Turn Lanes	35,600	34,400	34,200	32,200
4	Divided	Without Left Turn Lanes	30,000	29,000	29,000	26,000
		With Left Turn Lanes	39,400	38,000	37,000	36,000
		With Left and Right Turn Lanes	41,800	40,200	39,200	38,200
6	Divided	Without Left Turn Lanes	45,200	46,000	43,600	41,600
		With Left Turn Lanes	59,200	57,200	55,800	54,400
		With Left and Right Turn Lanes	62,600	60,400	60,400	57,600
8	Divided	Without Left Turn Lanes	78,800	76,200	74,400	72,600
		With Left Turn Lanes	83,400	80,600	80,600	76,800

Table 9 – One Way Urban Arterial Street Segment Capacities

Outside CBD	
Number of Lanes	Capacity (vpd)
1	7,200
2	14,600
3	22,400
4	29,800

Inside CBD	
Number of Lanes	Capacity (vpd)
1	7,700
2	15,600
3	23,400
4	31,300

Note: These tables represent ultimate capacity used in travel demand modeling. They represent the threshold for when a facility is expected to cross from LOS D to LOS E. These should be used as a planning level guidance only and be checked against demand and capacity of each facility being studied

Each arterial corridor segment within the study area with more than one lane per direction was evaluated as a potential road diet candidate. The existing and projected 2040 traffic volumes for each corridor segment were compared to the planning level capacities shown in Tables 5a and 5b to determine the ultimate volume to capacity (v/c) ratio. A segment with v/c ratio approaching 1.0 (approximately <0.85) was used to identify potential road diet candidates. Additionally, locations were screened for those within the top 25 crash segments or were included in the AMP, noting that some locations do have volumes exceeding the capacity guidelines above and will need to be confirmed in preliminary design. A summary of potential road diet segments is outlined in **Table 10**.

Table 10 – Potential Road Diet Candidates

Corridor	Extents	ADT		Assumed Segment Capacity	Top 15 Crash Segment	Included in AMP[1]	Notes
		Current (Year)	Future (2045)				
Drake Rd	Overland Trail to Taft Hill Rd	13,900 (2019)	18,000	17,000		X	Verify capacity near S. Taft Hill
JFK Pkwy	Harmony Rd to Horsetooth Rd	6,800 (2019)	10,100	15,400		X	
Jefferson Street	Mountain Ave to College Ave	9,300 (2018)	8,900	11,700	X	X	
Riverside Ave	Lemay Ave to Prospect Rd	14,800 (2018)	17,800	15,400			Verify overall capacity
Shields St	Mulberry St to Mountain Ave	11,900 (2018)	14,500	15,400		X	
Troutman Pkwy	Mason St to Boardwalk Dr	5,600 (2019)	8,300	15,400	X		
Ziegler Rd	Rock Creek Dr to Harmony Rd	12,000 (2018)	17,800	17,000		X	

1. In draft version of the AMP currently under review by City of Fort Collins.

In urban settings, delay tends to be experienced at intersections. Therefore, segment capacities were used as a measure for screening of road diet candidates. Detailed intersection analyses will be carried out during Phase 2 to verify feasibility of the lane reconfigurations.

2.3 Top Locations

The high-level safety and congestion analysis conducted in Phase 1 produced a list of corridors and intersections throughout the study area that provided opportunity to improve operations. In this process, data was assessed to identify which roadways and intersections presented the highest needs in terms of delay, traffic operations, and safety or those that provide the greatest opportunity to improve the multimodal network or combine with other identified needs. Specific reasons for selecting segments for congestion or safety needs are discussed in the preceding sections. From this analysis, priority intersections and corridors were identified to funnel into Phase 2, to develop into projects.

3. PHASE 2 – PROJECT SELECTION

The highest-ranking (lowest performing) intersections and roadway segments identified in Phase 1 were reviewed in more detail to determine potential projects that would provide the greatest opportunity for feasible, impactful projects. Top locations from the lists of intersections with congestion or safety issues (**Tables 4** and **5**, respectively), top crash segments (**Table 6**), and road diet candidates (**Table 9**) were selected and assembled into projects. This process was largely collaboration within the project team and the City of Fort Collins to identify locations that have an identified need, do not have a previously programmed project, and can address multiple proximate issues. For example, an intersection with safety or congestion issues may be coupled with an adjacent street segment with safety issues to create a project.

To aid in selection of top projects, a series of quantitative criteria were developed and applied to the identified projects. These criteria were developed in coordination with the City of Fort Collins and aligned with the AMP to best achieve the current goals of the city. These criteria are explained in detail in the following sections.

Each project was evaluated against the Quantitative and Qualitative Criteria, resulting in a a score for each criterion. Individual criterion scores were then combined to create a total score for each project, and projects were ranked in order based on these scores. From this ranking the top 15 projects were identified to move into the next Phase.

3.1 Project Identification

The priority intersections and segments identified in Phase 1 were further studied to identify improvements that would address safety, congestion, multimodal comfort, multimodal network and future traffic growth. Each project was summarized into the following Project Types and Project Categories . These projects are illustrated in **Figure 2**. A table showing the potential projects, descriptions, and purposes is shown in **Appendix C.**

Roundabouts were considered for project solutions, however, due to the amount capital investment, there would not be a commensurate safety benefit as compared to other project types.

Project Type

- Intersection improvements
- Corridor improvements
- Road diets
- New construction

Project Category

- Capital
- Studies
- Operational

Identified projects that are recommended for additional study to determine potential solutions have been categorized as studies. These projects have also been separated out from the prioritization process and are listed in **Table 11**.

Table 11 – Study Recommendation List

Project Name	Project Location	Type	Description
College Avenue Corridor Improvements	Olive to Cherry	Corridor Improvements	Planning Project: Safety improvements through downtown (TBD), include Cherry Ave
Harmony Corridor	Boardwalk to Mason	Corridor Improvements	Corridor Study: to review access control, safety and multimodal improvements
Mountain Avenue Corridor Improvements	Mason to Jefferson	Corridor Improvements	Roadway and multimodal Improvements being planned as separate project

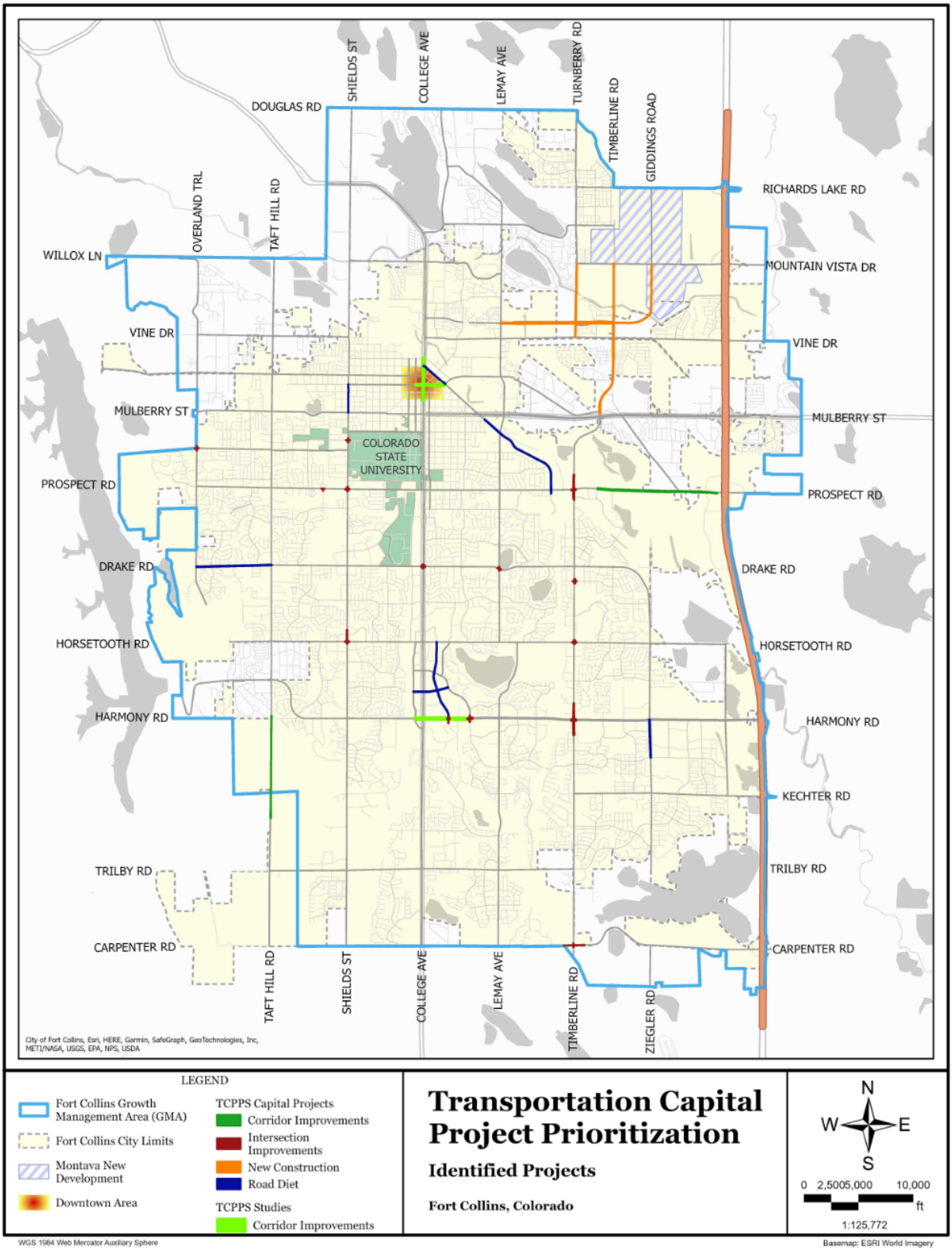

Figure 2 – Identified Projects Map

Note that identified solutions to issues at many locations, particularly intersections, were relatively simple to implement and were thus categorized as Operational projects. These projects were separated from the potential capital project list and provided to Fort Collins Traffic Operations team for implementation independent of development and execution of the capital improvement plan. A list of the operational projects is shown in **Table 12.**

Table 12 – Operational Project Recommendations List

Project Name	Type	Description
College & Mulberry	Intersection Improvements	Signal Retiming: Add LPIs all directions (active only w/ped call)
College & Vine	Intersection Improvements	Signal Modification: Restrict WB RTOR, add WB overlap signal head
College & Willox	Intersection Improvements	Signal Retiming: Consider protected left-turn NB/SB during peak hours
Lemay & Carpenter	Intersection Improvements	Signal Modification: Add SB flashing yellow arrow and SB protected-permissive phasing (consider increasing cycle length)
Lemay & Horsetooth	Intersection Improvements	Signal Modification: Replace far-side right-turn overlap signal; install new near-side right-turn overlap signal
Mcclelland & Horsetooth	Intersection Improvements	No project identified.
Shields & Harmony	Intersection Improvements	Signal Timing/Phasing: Protect-only EB/WB left-turns, add WB RT overlap phase.
Shields & Trilby	Intersection Improvements	Signal Modifications: Add EB & WB flashing yellow arrow left-turn heads and protected/permissive left-turn operation
Stover & Prospect	Intersection Improvements	Signing: Add overhead school crossing signs on existing signal mast arms.
Taft Hill & Mulberry	Intersection Improvements	Signal Timing: Extend eastbound and westbound all-red time from 1.5 to 2 sec.
Taft Hill & Prospect	Intersection Improvements	Signal Modifications: Add 2nd overhead signal heads (over each through lane), SB, NB and EB; add SB flashing yellow arrow left-turn head with protect-only operation by peak hour
Timberline & Custer	Intersection Improvements	Signing and Marking: Provide additional signing and marking to deconflict right-turns w/bicyclists
Timberline & Drake	Intersection Improvements	Signal Modification: Add EB and WB RT overlap signals/phases

3.2 Quantitative Scoring Criteria

Capital projects and studies progressed in the quantitative scoring. Additionally, new construction projects, identified by a judgment-based selection from new segments planned in the Montava area, were included for scoring. Studies will not be considered for overall project prioritization; however, this information will be used to prioritize these projects in the future and will be included in the Management Tool. Additional congestion and safety calculations were completed as a part of the quantitative scoring shown in **Appendix C.**

Crash Reduction

Crash reduction includes the reduction in total crashes per year due to the recommended improvements. This measure was evaluated for the period from January 2015 to August 2020. Crash reduction factors associated with the proposed improvements were selected from the CMF Clearinghouse to identify the potential annual crash reduction. Scoring descriptions are shown in **Table 13.** Note that separate scoring was developed for New Construction projects.

Table 13 – Crash Reduction Per Year Score

New Construction	
Measurement	**Score**
L**ow -** Minimal apparent safety benefit	1
-	-
M**edium -** Provides some benefit at existing intersections	3
-	-
High - Provides clear safety benefit to all modes of travel, particularly at intersections	5

Road Diets, Intersection and Corridor Improvements	
Measurement	**Score**
0 - 4 annual crash reduction	1
>4 - 8 annual crash reduction	2
>8 - 12 annual crash reduction	3
>12 - 16 annual crash reduction	4
>16 annual crash reduction	5

Peak Hour Delay Reduction

Level of Service (LOS) is a quantitative measure used to describe how much delay a driver experiences during individual turning movements and at intersections. LOS is calculated as an average delay per second for these specific movements during peak hours of traffic throughout the day. The Peak Hour Delay Reduction evaluation measure focuses on the average seconds of delay reduced across all peak hours of the day as a result of recommended roadway improvements. Individual intersections and non-intersection road segments are provided a score depending on how many average seconds of delay have been reduced. Scoring descriptions are shown in **Table 14.**

Table 14 – Peak Hour Delay Reduction Score

New Construction	
Measurement	**Score**
Low - Minimal apparent peak hour delay reduction	1
-	2
Medium - Provides some delay reduction	3
-	4
High - Provides high delay reduction	5

Road Diets, Intersection and Corridor Improvements	
Measurement	**Score**
< 2 seconds	1
>2 - 4 seconds	2
>4 - 6 seconds	3
>6 - 8 seconds	4
>8 seconds	5

Equity

This criterion emphasizes the importance of considering how a project affects health and equity of the community. The Health and Equity Index (HEI) developed by using data from Fort Collins Health Equity Index. The HEI identifies the most vulnerable communities. Scoring is based on the values provided within this HEI. Scoring descriptions are shown in **Table 15**.

Table 15 – Equity Score

Measurement	Score
0 - 15	1
16 - 30	2
31 - 45	3
46 - 60	4
61-100	5

Growth

This criterion represents the expected growth in traffic annually as determined by travel demand modeling performed by the North Front Range Metropolitan Planning Organization (NFRMPO). How the project relates to this growth may influence project design and implementation. Scoring descriptions are shown in **Table 16**.

Table 16 – Annual Growth Score

Measurement	Score
< 2%	1
-	-
>2% - 4%	3
-	-
> **4%**	5

3.3 Qualitative Scoring Criteria

Following the quantitative scoring, the capital projects and studies progressed in qualitative scoring. The qualitative scoring criteria were developed to provide a way to capture intangible benefits and impacts to the community. The best available information is used throughout the qualitative scoring process to facilitate initial project prioritization recommendations. These criteria are later updated as additional information through Phase 3.

Cost

This criterion is based on the total cost estimate for each project. The total conceptual cost includes high level estimates of construction, utilities, Right-of-Way, design fees, and construction administration costs based on the engineering judgement. Scoring descriptions are shown in **Table 17** – Cost Score

Table 17 – Cost Score

Measurement	Score
$0 - $100,000	5
>$100,000 - $500,000	4
>$500,000 - $1,000,000	3
>$1,000,000 - $5,000,000	2
> $5,000,000	1

Synergy

This criterion addresses the potential to support other currently funded or programmed public or private projects. This does not include compatibility with other master plans. The larger the score, the closer the project is in proximity to another identified public infrastructure project or private development project and the more likely it is able to support one or both of the existing projects. Scoring descriptions are shown **Table 18**.

Table 18 – Synergy Score

Measurement	Score
Does not provide benefit to another public or private project.	1
-	-
May provide an approximate benefit to another public or private project.	3
-	-
Provides a direct benefit to another public or private project.	5

Readiness

This criterion involves an evaluation of overall complexity that may contribute to additional effort by the City of Fort Collins or the engineering teams prior to the project being ready for final design and construction. The risk to the project schedule was assigned to each of the sub criterion to determine this score, including likelihood of funding, need for right-of-way acquisition, impact to rail or utilities as well as utility relocation by others, and potential environmental impacts. Due to the potential for schedule risks to overlap, the highest schedule risk is used to rank each project. Scoring descriptions are shown in **Table 19.**

Table 19 – Readiness Score

Sub Criterion	Measurement	Risk to Schedule (Months)
Right of Way Impact	None - No ROW or Easements are identified	0
	Minor - Only a few parcels need ROW or easements (ex: Intersection Improvement)	9
	Major - More than 5 parcels will need ROW of easements (ex: corridor improvement)	18
Railroad or Utility Impact	Low - No or minimal impact to utilities (ex: striping project)	0
	Medium - Some utilities may be impacted (ex: moving curb)	9
	High - Extensive utility impacted anticipated (ex: corridor widening project)	18
Environmental Impact	Low - No or minimal environmental resources are impacted (ex: striping project)	0
	Medium - Some environmental resources are impacted (ex: moving curb)	9
	High - Extensive environmental resources impacted (ex: new location corridor improvement)	18
Availability of Funding Impact	Programmed - Project is in progress and funding has been secured.	0
	Sources Identified - Projects that have options of potential funding.	9
	None - Project is on hold due to other issues.	18

Measurement	Score
0 – 12 months	5
>12 – 24 months	3
> 24 months	1

Multimodal Benefit

The multimodal benefit criterion considers a project's relative benefit to the multimodal network, such as addressing connectivity or improving comfort, and evaluates how well the project will reduce dependency on single-occupancy vehicles and create safe options for people to ride, walk, and take transit. Increased ability of a project to support this mode shift additionally helps to implement goals of the Climate Action Plan. The scoring for this measure is based on a qualitative analysis of how the project contributes to the overall multimodal network. This scoring for this criterion combines input from other Fort Collins plans including the AMP and Transit Master Plan. A direct benefit signifies that AMP recommendations are accomplished with the project, while an indirect benefit signifies that AMP recommendations can be partially completed to setup for the future. A project with a transit benefit has an existing or proposed transit facility within the project limits. Scoring descriptions are shown in **Table 20.**

Table 20 – Multimodal Benefit Score

AMP Benefit	Transit Plan Benefit	Score
None	No	1
None	Yes	2
Indirect	No	2
Indirect	Yes	3
Direct	No	4
Direct	Yes	5

Community

The Community criterion considers how well implementation of the project addresses community needs and interests. Scoring is based on whether the project will address feedback received from public engagement surveys, as well as the proximity and connectivity of the project to identified Community Activity Centers. Public engagement results and Community Activity Center locations are noted in the Screening Tool. Scoring descriptions are shown in **Table 21.**

Table 21 – Community Score

Number of Public Comments	Benefit to Community Activity Center	Score
0 comments	No	1
	Yes	2
1 – 5 comments	No	3
	Yes	3
> 6 comments	No	4
	Yes	5

3.4 Phase 2 Results

The total score for each project is computed by applying a base weighting scheme to each of the scoring criteria and summing the values. The base weighting scheme represents (in decreasing weight) improving core metrics of safety and congestion, addressing feasibility of projects through funding availability and readiness, and acknowledging the overall community priorities of equitable and multimodal solutions. The base weighting scheme used is shown in **Table 22.**

Table 22 – Base Weighting Scheme

Delay	Safety	Health Equity	Growth	Cost	Readiness	Multimodal Benefit	Synergy	Community
5	5	2	1	3	3	2	1	1

The top 15 projects that have been recommended to move into Phase 3 for continued development and prioritization refinement as shown in **Table 23**. Additional project details, total scores and draft prioritization of all projects are shown in **Appendix C**.

Table 23 – Top 15 Initial Project Recommendation List

Project Name	Project Status	Base Total Score	Total Ranking
Shields & Prospect	Active	88	1
Vine Drive & Timberline Road Overpass	Active	87	2
S Overland Trl & W Elizabeth St	Programmed – In Progress By Others	81	-
N Timberline Road - Segment 1	Active	81	3
Troutman Corridor Improvements & JFK Road Diet	Active	80	4
Jefferson Avenue Corridor Improvements	Programmed – In Progress By Others	74	-
Lemay & Drake	In Progress – Previous Task Order	72	-
College & Drake	Programmed – In Progress By Others	71	-
Boardwalk & Harmony	Active	71	5
Harmony & JFK/Hogan	Active	69	6
Riverside Avenue Road Diet	Active	69	7
Drake Road Diet	Active	69	8
Prospect Corridor Improvements	Active	68	9
Shields & Horsetooth	Active	68	10
N Timberline Road - Segment 2	Active	68	11
Shields & Plum	Delayed – Coordination by Others	67	-
Heatheridge & Prospect	Active	66	12
Suniga Road	Active	62	13
Timberline & Carpenter	Active	58	14
Shields Road Diet	In Progress – Previous Task Order	58	-
Timberline & Harmony	Active	54	15

4. PHASE 3 – CONCEPT DEVELOPMENT

The recommended list of projects developed in Phase 2 will proceed into Phase 3 for conceptual design development, high-level cost estimation, and environmental screening. These projects will be recommended for implementation to the capital projects program as funding is identified.

4.1 Concept Design

A horizontal conceptual design will be prepared for projects shown in the initial project list in **Table 23**. Conceptual designs will be overlaid on aerial imagery for each project location identified to propose a solution to the capacity and safety issue identified. Designs shall utilize existing parcel lines to design a feasible solution that balances impacts and costs. The horizontal concept will be refined with the City of Fort Collins. Conceptual design figures will be shown in **Appendix E.**

4.2 Cost Estimation

High level cost estimates will be prepared for each project recommended and will include the construction, right of way, utility relocation, engineering fee, and construction administration costs. These estimates will be based on the historical city cost data.

4.3 Environmental Study

Olsson completed a desktop review of publicly available datasets to identify potential environmental resources within expected project boundaries of individual projects. The objective of the review was to evaluate each project for impacts to environmental features and possible environmental risks. The desktop review was completed by investigating publicly available datasets, which depict the potential locations of a variety of environmental resources. The datasets were compiled in a geographic information system (GIS), and map figures are included in **Appendix F**. The following publicly available resources were used to complete the desktop review:

- Soil Survey Geographic (SSURGO) Database (USDA Natural Resources Conservation Service [NRCS] 2018)
- Colorado Parks and Wildlife (CPW). 2022. Non-Disclosure Agreement Nest Data
- USGS 2022 National Hydrography Dataset (NHD). U.S. Dept. of the Interior, U.S. Geological Survey
- National Wetlands Inventory (NWI), Version 2 (U.S. Fish and Wildlife Service [USFWS] 2020)
- Colorado Parks and Wildlife (CPW) and Colorado Oil and Gas Conservation Commission (COGCC) SB 181 High Priority Habitat (HPH) (2022)

- U.S. Geological Survey (USGS) Gap Analysis Project (GAP) 2022, Protected Areas Database of the United States (PAD-US) Version 3.0
- City of Fort Collins Natural Areas 2022
- National Flood Hazard Layer (NFHL) Larimer County, FEMA Floodplain 2022

Based on the desktop review of these resources, individual projects have been categorized according to perceived environmental impacts and need for further analysis, as described below. Three categories were used to summarize the environmental risk based on this initial desktop review. The Low-Risk category indicates no environmental features were observed within the project impact area. The Medium-Risk category indicates that wildlife resources or a raptor nesting boundary was observed intersecting with the project area of impact, but no wetlands or other water resources including potentially jurisdictional Waters of the United States (WOTUS) were observed within the project area. The High-Risk category indicates that wetlands or other water resources including potentially jurisdictional Waters of the United States (WOTUS) were observed within the project area and may include other observed environmental features within the project area.

Additional Analysis

Field visits have been recommended for individual projects where one or more environmental factor potentially impacting the site has been observed. The need for an additional Environmental Database Report (EDR) was determined based on the level of anticipated surface impacts for an individual project, where those projects with substantial new surface impacts were determined to need an EDR.

4.4 Final Revised Scores & Recommendations

After the completion of Phase 3, the conceptual designs, cost estimates and environmental screening for each of the recommended projects will facilitate updates to the scores to reflect the new information determined during Phase 3. A revised base weight scoring will be applied to each project to generate a newly ordered list of recommended projects. These recommended projects will be used to facilitate overall prioritization discussions within the city.

5. IMPLEMENTATION

5.1 City Priorities – Weighting

Recognizing that the base weighting scheme is appropriate for determining a list that meets the values and needs identified in this study effort, additional weighting schemes will be developed in coordination with the City to re-sort the recommended projects to align with the goals various stakeholders or funding opportunities. Potential weighting scenarios that will be investigated in the next phase of this study will place emphasis climate change, mode shift, or multi-department projects.

5.2 Funding Sources

Traditionally, capital projects are funded through two main avenues: the Budgeting for Outcomes (BFO) process and grants/ matching opportunities. Through the BFO process, projects apply for funding with the City and have a larger chance of success if the project aligns with the City's goals. Currently projects that score high in this process align with mode shift, climate change or multi-department projects. The BFO process occurs every 2 years, in which projects are submitted to City Council for recommendation and selection.

Additionally, a large portion of capital projects are funded by grants. If projects qualify for grants, the BFO traditionally will approve the matching amount off-cycle. The following is a list of grants that have been used in the past.

- Congestion mitigation and air quality improvement program (CMAQ)
- Surface Transportation Block Grant (STBG)
- Highway Safety Improvement Program (HSIP)
- Funding Advancements for Surface Transportation and Economic Recovery Act of 2009 (FASTER)
- Multi-modal transportation and mitigation options fund (MMOF)
- Vision Zero Grants

Appendix A
Public Engagement Summary

NOTE: INCLUDED AS SEPARATE ATTACHMENT

Appendix B
GIS Users Manual

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Screening Tool Instructions
Management Tool Instructions
GIS Documentation

NOTE: THIS SECTION IS IN DEVELOPMENT

Appendix C
Phase 2 Project Lists

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Identified Projects List
Projects Scoring List

Table C1 - Identified Projects List

Project Description						Project Purpose				
Project Name	Project Limits	Project Type	Project Category (Study, Capital, Operational)	Potential Improvements	Notes	Safety	Congestion	Multimodal Comfort	Multimodal Network	Traffic Growth
Boardwalk & Harmony	-	Intersection Improvements	Capital	Signal Rebuild: longer NB mast-arm to improve NB signal head alignment, add LT side-of-pole heads, upgrade all LT to FYA; ped. button accessibility; retiming	Long term when the city looks at Harmony from College to Mason they could incorporate geometric improvements Review access to the north related to crash history	X				
College & Drake	-	Intersection Improvements	Capital	Intersection Rebuild: add EB & WB prot-only dual lefts, add RT bypass islands all approaches (w/RT overlap signals)	Improves PM peak LOS from E to D (WB, SB and NB all improve 1 letter grade) In Progress		X			
Drake Road Diet	Overland Trail to Taft	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, consider raised median sections (ped refuge at Featherstar Way on W leg w/enhanced crossing)	Get TMCs at Drake & Hampshire to inform design and where lane drop/add occurs			X	X	
Giddings Road	Timberline to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development; not included in Montava TIS				X	X
Harmony & JFK/Hogan	-	Intersection Improvements	Capital	Intersection & Signal Rebuild at JFK/Hogan: remove NB/SB split phase by shifting SB dual LT east (1 NB departure lane), widen south leg to east; add WB RT overlap	Removing split phase w/intersection rebuild at Hogan/JFK improved PM peak LOS from C to D, NB & SB LOS E/F to LOS D		X			
Heatheridge & Prospect	-	Intersection Improvements	Capital	New Traffic Signal: Replace existing HAWK with full, three-leg traffic signal; add adv. crossing signs; consider raised median/ped refuge on west leg for speed mitigation and added protection for peds	Current HAWK beacon does not meet MUTCD spacing from stop-sign controlled side-street (100' min)	X		X		
Jefferson Avenue Corridor Improvements	Mountain to College	Road Diet	Capital	Westbound Lane Repurposing for parking and/or multimodal improvements	Linden intersection operates LOS B overall in peak hours w/reduced laneage; checked 2040 growth would still operate LOS B/acceptable	X		X	X	
JFK Road Diet	Harmony to Horsetooth	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage	No change in LOS letter grade at either Troutman or Broadway with JFK thru lane reductions; need to coordinate w/Actives Mode Plan	X		X	X	
Lemay & Drake	-	Intersection Improvements	Capital	Intersection Rebuild (Project Funded): Straighten EB/WB curves, add SB RTL w/overlap phase; add WB RT overlap phase; misc. markings and signing, access control on south leg and at Edinburgh	Realignments may alleviate need for protected-only left-turn phasing, but this may be needed in future; monitor LT crashes after rebuild (use FYA so LT phasing can be time of day, if needed) In Progress	X	X			
Overland & Elizabeth	-	Intersection Improvements	Capital	Construct Roundabout: Construct a single-lane roundabout.	To be planned/designed as part West Elizabeth project In Progress	X				
Prospect Corridor Improvements	Sharp Pointe to I-25	Corridor Improvements	Capital	Widen to 5-Lane Section	In Progress		X	X	X	X
Riverside Avenue Road Diet	Lemay to Prospect	Road Diet	Capital	Lane Repurposing: Narrow roadway to add two-way cycle track on south side of roadway and associated intersection improvements; transition to 2-way off-street, multi-use path at Lemay to Myrtle. Bike lane restriping west on Myrtle to Whedbee.	2-way cycle track on south side minimizes driveway conflicts; LOS E/F for some Riverside approaches in peak hours; transition to off-street path at Lemay and to the west to maintain capacity.			X	X	
Shields & Horsetooth	-	Intersection Improvements	Capital	Intersection Rebuild and Access Restriction: Extend SB LT storage, restrict Richmond/Shields intersection by extending median to the north; add WB RT overlap signal and phase. Protect-only SB LT.	Additional analysis at Richmond/Shields to assess access control and diverted volumes/associated impacts.	X	X			
Shields & Plum	-	Intersection Improvements	Capital	Construct Protected Intersection: To improve bicyclist and pedestrian safety.	Consider event traffic	X				
Shields & Prospect	-	Intersection Improvements	Capital	Add Westbound Right-Turn Lane: Add WB right-turn lane with RT overlap signal. Consider SB protected-only left-turn operation.	Adding WB RT lane improves PM peak approach from LOS F to LOS C		X			
Shields Road Diet	Mulberry to Mountain	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage				X	X	
Suniga Road	Lemay to Timberline	New Construction	Capital	Roadway New Construction	Plan with development				X	X
Taft Hill Corridor Improvements	LC Landfill to Fromme Prairie	Corridor Improvements	Capital	Improve Shoulders: Add shoulders/widen existing shoulders to improve bicyclist comfort and safety; improve animal crossing/warning signage.		X				
Timberline & Carpenter	-	Intersection Improvements	Capital	Auxiliary Lane Improvements: Extend WB right-turn and EB left-turn lanes to increase storage and deceleration lengths (Short-Term)	Existing EB and WB auxiliary lanes are below CDOT access code standards, may be contributing to rear end crashes; long-term widening for additional EB/WB through lanes may be needed	X				
Timberline & Harmony	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS; Add RT bypass islands to shorten pedestrian crossings.	Adding 3rd NB/SB thru lanes would improve EB, NB and SB approach LOS by one letter grade (and no approaches at LOS F) in worst (PM) peak hour		X			
Timberline & Horsetooth	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS	Adding 3rd NB/SB thru lanes would improve overall LOS from LOS D to LOS C in all peak hours		X			
Timberline & Prospect	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS	Adding 3rd thru lanes has marginal LOS benefit, as limited green time available due to demand from large left-turn volumes (NB, WB); 3rd NB LT lane and 3rd WB thru lane also marginal benefit.		X			
Timberline Road North - Segment 1	Lincoln to Vine	New Construction	Capital	Roadway New Construction	Plan with development	X	X		X	X

Table C1 - Identified Projects List

Timberline Road North - Segment 2	Vine to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development				X	X
Troutman Corridor Improvements	Mason to Boardwalk	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage		X		X	X	
Turnberry Road	Vine to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development				X	X
Vine Drive & Timberline Road Overpass	Vine Dr to Timberline Rd	New Construction	Capital	Overpass: Railroad Viaduct over Vine Drive along Timberline						
Ziegler Road Diet	Rock Creek to Harmony	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage				X	X	
College & Mulberry	-	Intersection Improvements	Operational	Signal Retiming: Add LPIs all directions (active only w/ped call)	LPI will increase delay when active; wayfinding, bikes over to Remington; long-term imp. wider sidewalks for mixed bike + ped traffic.	X	X			
College & Vine	-	Intersection Improvements	Operational	Signal Modification: Restrict WB RTOR, add WB overlap signal head	Reevaluate after Suniga extension/signal completed; traffic shift may alleviate need	X				
College & Willox	-	Intersection Improvements	Operational	Signal Retiming: Consider protected left-turn NB/SB during peak hours	Look for opportunity to modify west leg geometry (redevelopment)	X				
Lemay & Carpenter	-	Intersection Improvements	Operational	Signal Modification: Add SB flashing yellow arrow and SB protected-permissive phasing (consider increasing cycle length)		X				
Lemay & Horsetooth	-	Intersection Improvements	Operational	Signal Modification: Replace far-side right-turn overlap signal; install new near-side right-turn overlap signal	Increased signal visibility may reduce EB rear-end collisions.	X				
Mcclelland & Horsetooth	-	Intersection Improvements	Operational	No project identified.	High EB rear-ends likely congestion related from College.	X				
Mulberry Corridor Improvements	College to Greenfield	Corridor Improvements	Operational		Project awarded CMAQ funding for adaptive signal implementation		X			
Shields & Harmony	-	Intersection Improvements	Operational	Signal Timing/Phasing: Protect-only EB/WB left-turns, add WB RT overlap phase.	To mitigate EB/WB left-turn crashes and service high-volume right-turn (441 vph PM peak)	X				
Shields & Trilby	-	Intersection Improvements	Operational	Signal Modifications: Add EB & WB flashing yellow arrow left-turn heads and protected/permissive left-turn operation		X				
Stover & Prospect	-	Intersection Improvements	Operational	Signing: Add overhead school crossing signs on existing signal mast arms.		X				
Taft Hill & Mulberry	-	Intersection Improvements	Operational	Signal Timing: Extend eastbound and westbound all-red time from 1.5 to 2 sec.	To mitigate WB right-angle crashes	X	X			
Taft Hill & Prospect	-	Intersection Improvements	Operational	Signal Modifications: Add 2nd overhead signal heads (over each through lane), SB, NB and EB; add SB flashing yellow arrow left-turn head with protect-only operation by peak hour	To mitigate rear-end and SB LT crashes	X				
Timberline & Custer	-	Intersection Improvements	Operational	Signing and Marking: Provide additional signing and marking to deconflict right-turns w/bicyclists		X				
Timberline & Drake	-	Intersection Improvements	Operational	Signal Modification: Add EB and WB RT overlap signals/phases	Improves AM approach LOS from LOS E/F (EB/WB) to LOS D/D and overall LOS from D to C in AM peak		X			
College Avenue Corridor Improvements	Olive to Cherry	Corridor Improvements	Study	Planning Project: Safety improvements through downtown (TBD), include Cherry Ave		X	X			
Harmony Corridor	Boardwalk to Mason	Corridor Improvements	Study	Corridor Study: to review access control, safety and multimodal improvements		X	X	X		
Mountain Avenue Corridor Improvements	Mason to Jefferson	Corridor Improvements	Study	Roadway and multimodal Improvements being planned as separate project	In Progress	X		X	X	

Table C2 - Project Scoring List

							Quantitative Values				Quantitative Scores				Qualitative Values										Qualitative Scores					Total Score			Total Rank
															Cost	Readiness				Multimodal Benefit		Synergy	Community										
Project Name2	Project Limits	Project Type	Project Category (Study, Capital, Operational)	Potential Improvements	Notes	Project Status	Peak Hour Delay Reduction (Seconds)	# of Reduced Crashes	Health Equity Score	% Traffic Growth	Delay	Safety2	Equity	Growth2	Cost	Availability of Funding	Utility Impact	ROW Impact	Environmental Impact	Active Mode Plan Benefit	Transit Plan Benefit	Synergy	Community Center Benefit	Number of Public Comments	Cost1	Readiness	Multimodal Benefit2	Synergy2	Community	Base Total Score	Congestion Focus Total Score	Safety Focus Total Score	Total Ranking
Shields & Prospect	-	Intersection Improvements	Capital	Add WB right-turn lane with RT overlap signal. Consider SB protected-only left-turn operation.	Adding WB RT lane improves PM peak approach from LOS F to LOS C	Active	-5.1	25	66		3	5	5	1		Sources Identified	Medium	Minor	Low	None	Yes	Unknown	Yes	4	4	5	2	3	3	88	88	102	1
Vine Drive & Timberline Road Overpass	Vine Dr to Timberline Rd	New Construction	Capital	Overpass: Railroad Viaduct over Vine Drive along Timberline	Active Modes - Sidepaths on Timberline.	Active	High	High	53		5	5	4	3		Sources Identified	High	Major	Medium	Direct	No	Unknown	No	4	1	3	4	3	3	87	99	93	2
S Overland Trl & W Elizabeth St	-	Intersection Improvements	Capital	Construct Roundabout: Construct a single-lane roundabout.	To be planned/designed as part West Elizabeth project In Progress Active Modes - Separated Bike Lanes on West Elizabeth St	Programmed	0	18	40		4	5	3	2		Programmed	High	Minor	Medium	Indirect	Yes	Unknown	No	6	2	3	3	3	4	81	87	91	3
N Timberline Road - Segment 1	Lincoln to Vine	New Construction	Capital	Roadway New Construction	Plan with development Active Modes - Separated Bike Lanes	Active	High	Medium	53		5	3	4	3		Sources Identified	High	Major	High	Direct	No	Unknown	No	8	2	3	4	3	4	81	99	77	3
Troutman Corridor Improvements & JFK Road Diet	Mason to Boardwalk & Harmony to Horsetooth	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage Access Restrictions near JFK and Harmony and Troutman and College	No change in LOS letter grade at either Troutman or Broadway with JFK thru lane reductions; Combining Troutman Corridor Improvement and JFK to optimize Active Modes - Separated Bike Lanes and New Signalized Crossing at Pavilion Lane	Active	0	47	37		1	5	3	1		Sources Identified	Medium	None	Medium	Direct	Yes	Unknown	No	5	4	5	5	3	3	80	67	97	5
Jefferson Avenue Corridor Improvements	Mountain to College	Road Diet	Capital	Westbound Lane Repurposing for parking and/or multimodal improvements	Linden intersection operates LOS B overall in peak hours w/reduced laneage; checked 2040 growth would still operate LOS B/acceptable Active Modes - Separated Bike Lane	Programmed	0		29		1	3	2	2		Programmed	Low	None	Low	Direct	Yes	Unknown	Yes	8	5	5	5	3	5	74	69	81	6
Lemay & Drake	-	Intersection Improvements	Capital	Intersection Rebuild (Project Funded): Straighten EB/WB curves, add SB RTL w/overlap phase; add WB RT overlap phase; misc. markings and signing, access control on south leg and at Edinburgh	Realignments may alleviate need for protected-only left-turn phasing, but this may be needed in future; monitor LT crashes after rebuild (use FYA so LT phasing can be time of day, if needed) In Progress Active Modes - Separated Bike Lanes on Drake Rd, Consider removing or redesigning slip lanes; both Lemay & Drake surfaced as safety challenges.	In Progress	-6	12.8	28		3	4	2	2		Sources Identified	Medium	Minor	High	Direct	Yes	Unknown	Yes	3	2	3	5	3	3	72	74	78	7
College & Drake	-	Intersection Improvements	Capital	Intersection Rebuild: add EB & WB prot-only dual lefts, add RT bypass islands all approaches (w/RT overlap signals)	Improves PM peak LOS from E to D (WB, SB and NB all improve 1 letter grade) In Progress Active Modes - Separated Bike Lanes on Drake	Programmed	-8.4	0	51		5	1	4	3		Programmed	Medium	Minor	Medium	Indirect	Yes	Unknown	No	1	1	5	3	3	3	71	96	58	8
Boardwalk & Harmony	-	Intersection Improvements	Capital	Signal Rebuild: longer NB mast-arm to improve NB signal head alignment, add LT side-of-pole heads, upgrade all LT to FYA; ped. button accessibility; retiming	Long term when the city looks at Harmony from College to Mason they could incorporate geometric improvements Review access to the north related to crash history Active Modes - Leading pedestrian interval, lagging right turns.	Active	0	8.3	40	2%	1	3	3	2		Sources Identified	Low	None	Low	Direct	Yes	Unknown	No	1	4	5	5	3	3	71	66	78	8
Harmony & JFK/Hogan	-	Intersection Improvements	Capital	Intersection & Signal Rebuild at JFK/Hogan: remove NB/SB split phase by shifting SB dual LT east (1 NB departure lane), widen south leg to east; add WB RT overlap	Removing split phase w/intersection rebuild at Hogan/JFK improved PM peak LOS from C to D, NB & SB LOS E/F to LOS D	Active	-6.7	0	37		4	1	3	3		Sources Identified	Medium	None	Low	None	Yes	Unknown	No	0	4	5	2	3	1	69	90	60	10
Riverside Avenue Road Diet	Lemay to Prospect	Road Diet	Capital	Lane Repurposing: Narrow roadway to add two-way cycle track on south side of roadway and associated intersection improvements; transition to 2-way off-street, multi-use path at Lemay to Myrtle. Bike lane restriping west on Myrtle to Whedbee.	2-way cycle track on south side minimizes driveway conflicts; LOS E/F for some Riverside approaches in peak hours; transition to off-street path at Lemay and to the west to maintain capacity.	Active	0	20.7	24		1	5	2	1		Sources Identified	Medium	Minor	Medium	None	Yes	Unknown	No	5	3	5	2	3	3	69	59	89	10
Drake Road Diet	Overland Trail to Taft Hill Rd	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, consider raised median sections (ped refuge at Featherstar Way on W leg w/enhanced crossing)	Get TMCs at Drake & Hampshire to inform design and where lane drop/add occurs Active Modes - Road Diet w/ separated bike lanes	Active	0	13.2	30		1	4	2	1		Sources Identified	Medium	None	Low	Direct	No	Unknown	No	8	3	5	4	3	4	69	60	82	10
Prospect Corridor Improvements	Sharp Pointe to I-25	Corridor Improvements	Capital	Widen to 5-Lane Section	In Progress	Active	-4.2	4.3	32		5	2	3	5		Sources Identified	High	Major	High	None	Yes	Unknown	Yes	1	1	3	2	3	3	68	95	61	13
Shields & Horsetooth	-	Intersection Improvements	Capital	Intersection Rebuild and Access Restriction: Extend SB LT storage, restrict Richmond/Shields	Additional analysis at Richmond/Shields to assess access control and diverted volumes/associated	Active	2.2	34	28		1	5	2	2		Sources Identified	Medium	Minor	Low	Indirect	Yes	Unknown	Yes	0	2	5	3	3	2	68	59	87	13
N Timberline Road - Segment 2	Vine to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development Active Modes - Include Sidepaths on Both Sides	Active	Medium	Medium	28		3	3	2	3		Sources Identified	High	Major	High	Direct	Yes	Unknown	Yes	1	2	3	5	3	3	68	75	69	13
Shields & Plum	-	Intersection Improvements	Capital	Construct Protected Intersection: To improve bicyclist and pedestrian safety.	Consider event traffic Delayed due to coordination with CSU Active Modes - Geometric Redesign, Refer to W Elizabeth BRT Design Concept	Delayed	0	7	47		1	2	4	2		Sources Identified	Medium	Minor	Medium	Direct	Yes	Unknown	Yes	0	4	5	5	3	2	67	65	69	16
Heatheridge & Prospect	-	Intersection Improvements	Capital	New Traffic Signal: Replace existing HAWK with full, three-leg traffic signal; add adv. crossing signs; consider raised median/ped refuge on west leg for speed mitigation and added protection for peds	Current HAWK beacon does not meet MUTCD spacing from stop-sign controlled side-street (100' min) Active Modes - Upgrade to full signal to	Active	0	5	34		1	2	3	2		Sources Identified	Medium	Minor	Low	Direct	Yes	Unknown	No	1	4	5	5	3	3	66	64	68	17
Suniga Road	Lemay to Timberline	New Construction	Capital	Roadway New Construction	Plan with development	Active	High	Low	30		5	1	2	5		Sources Identified	Medium	Major	High	None	Yes	Unknown	No	0	2	3	2	3	1	62	92	50	18
Timberline & Carpenter	-	Intersection Improvements	Capital	Auxiliary Lane Improvements: Extend WB right-turn and EB left-turn lanes to increase storage and deceleration lengths (Short-Term)	Existing EB and WB auxiliary lanes are below CDOT access code standards, may be contributing to rear end crashes; long-term widening for additional EB/WB through lanes may be needed	Active	-1.5	4.6	27		1	2	2	4		Sources Identified	Medium	Minor	Medium	None	No	Unknown	No	1	4	5	1	3	3	58	64	64	19

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Project Name2	Project Limits	Project Type	Project Category (Study, Capital, Operational)	Potential Improvements	Notes	Project Status	Peak Hour Delay Reduction (Seconds)	# of Reduced Crashes	Health Equity Score	% Traffic Growth	Delay	Safety2	Equity	Growth2	Cost	Availability of Funding	Utility Impact	ROW Impact	Environmental Impact	Active Mode Plan Benefit	Transit Plan Benefit	Synergy	Community Center Benefit	Number of Public Comments	Cost1	Readiness	Multimodal Benefit2	Synergy2	Community	Base Total Score	Congestion Focus Total Score	Safety Focus Total Score	Total Ranking
Shields Road Diet	Mulberry to Mountain	Road Diet	Capital	Road Diet, convert lane to protected bike lanes, multimodal improvements at intersections w/reduced vehicular laneage	Active Modes - Road Diet w/ separated Bike Lanes, Mulberry Intersection - Modify operations to increase separation for pedestrians; consider phase separation or exclusive pedestrian phase.	In Progress	0	2.8	21		1	1	2	1		Sources Identified	Low	None	Low	Direct	No	Unknown	No	4	4	5	4	3	5	58	58	56	19
Timberline & Harmony	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS; Add RT bypass islands to shorten pedestrian crossings.	Adding 3rd NB/SB thru lanes would improve EB, NB and SB approach LOS by one letter grade (and no approaches at LOS F) in worst (PM) peak hour Active Modes - Separated Bike Lanes & Separate right turns across crosswalks into protected phases, which may overlap with cross-street left turns. Prohibit right turn on red, or show flashing yellow arrow for right turns.	Active	-6.9	0	46		2	1	4	3		Sources Identified	High	Major	High	Direct	Yes	Unknown	Yes	4	1	3	5	3	3	54	62	48	21
Taft Hill Rd Corridor Improvements	LC Landfill to Fromme Prairie	Corridor Improvements	Capital	Improve Shoulders: Add shoulders/widen existing shoulders to improve bicyclist comfort and safety; improve animal crossing/warning signage.		Inactive	0	15.9	8		1	4	1	1		Sources Identified	Medium	Minor	High	None	No	Unknown	No	0	3	3	1	3	1	52	46	68	22
Timberline & Horsetooth	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS	Adding 3rd NB/SB thru lanes would improve overall LOS from LOS D to LOS C in all peak hours Active Modes - Separated Bike Lanes & Raised crossings at slip lanes	Inactive	-2.7	0	33		2	1	3	3		Sources Identified	High	Major	High	Direct	Yes	Unknown	Yes	1	1	3	5	3	3	52	60	46	22
Ziegler Road Diet	Rock Creek to Harmony	Road Diet	Capital	Lane Repurposing: Add Protected Bike Lanes, multimodal improvements at intersections w/reduced vehicular laneage		Inactive	0	3.29	20		1	1	2	1		Sources Identified	Low	Minor	Low	None	Yes	Unknown	No	2	4	5	2	3	3	52	54	52	22
Timberline & Prospect	-	Intersection Improvements	Capital	Intersection Rebuild: Add 3rd NB & SB through lanes to improve LOS	Adding 3rd thru lanes has marginal LOS benefit, as limited green time available due to demand from large left-turn volumes (NB, WB); 3rd NB LT lane and 3rd WB thru lane also marginal benefit. Active Modes - Separated Bike Lanes	Inactive	-2	0	5		1	1	1	3		Sources Identified	High	Major	High	Indirect	Yes	Unknown	No	7	1	3	3	3	4	40	45	39	25
Giddings Road	Timberline to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development; not included in Montava TIS	Inactive	Low	Low	28		1	1	2	1		Sources Identified	Low	Major	High	None	Yes	Unknown	No	0	2	3	2	3	1	38	40	38	26
Turnberry Road	Vine to Mountain Vista	New Construction	Capital	Roadway New Construction	Plan with development Active Modes - Add Separated Bike Lanes to complete the connection to Vine Street.	Inactive	Low	Low	30		1	1	2	1		Sources Identified	Medium	Major	Medium	Indirect	No	Unknown	No	0	2	3	2	3	1	38	40	38	26
College & Mulberry	-	Intersection Improvements	Operational	Signal Retiming: Add LPIs all directions (active only w/ped call)	LPI will increase delay when active; wayfinding, bikes over to Remington; long-term imp. wider sidewalks for mixed bike + ped traffic.	-	-	-	-	-																			0	0	0	28
College & Vine	-	Intersection Improvements	Operational	Signal Modification: Restrict WB RTOR, add WB overlap signal head	Reevaluate after Suniga extension/signal completed; traffic shift may alleviate need	-	-	-	-	-																			0	0	0	28
College & Willox	-	Intersection Improvements	Operational	Signal Retiming: Consider protected left-turn NB/SB during peak hours	Look for opportunity to modify west leg geometry (redevelopment)	-	-	-	-	-																			0	0	0	28
Lemay & Carpenter	-	Intersection Improvements	Operational	Signal Modification: Add SB flashing yellow arrow and SB protected-permissive phasing (consider increasing cycle length)		-	-	-	-	-																			0	0	0	28
Lemay & Horsetooth	-	Intersection Improvements	Operational	Signal Modification: Replace far-side right-turn overlap signal; install new near-side right-turn overlap signal	Increased signal visibility may reduce EB rear-end collisions.	-	-	-	-	-																			0	0	0	28
Mcclelland & Horsetooth	-	Intersection Improvements	Operational	No project identified.	High EB rear-ends likely congestion related from College.	-	-	-	-	-																			0	0	0	28
Mulberry Corridor Improvements	College to Greenfield	Corridor Improvements	Operational		Project awarded CMAQ funding for adaptive signal implementation	-	-	-	-	-																			0	0	0	28
Shields & Harmony	-	Intersection Improvements	Operational	Signal Timing/Phasing: Protect-only EB/WB left-turns, add WB RT overlap phase.	To mitigate EB/WB left-turn crashes and service high-volume right-turn (441 vph PM peak)	-	-	-	-	-																			0	0	0	28
Shields & Trilby	-	Intersection Improvements	Operational	Signal Modifications: Add EB & WB flashing yellow arrow left-turn heads and protected/permissive left-turn operation		-	-	-	-	-																			0	0	0	28
Stover & Prospect	-	Intersection Improvements	Operational	Signing: Add overhead school crossing signs on existing signal mast arms.		-	-	-	-	-																			0	0	0	28
Taft Hill Rd & Mulberry	-	Intersection Improvements	Operational	Signal Timing: Extend eastbound and westbound all-red time from 1.5 to 2 sec.	To mitigate WB right-angle crashes	-	-	-	-	-																			0	0	0	28
Taft Hill Rd & Prospect	-	Intersection Improvements	Operational	Signal Modifications: Add 2nd overhead signal heads (over each through lane), SB, NB and EB; add SB flashing yellow arrow left-turn head with protect-only operation by peak hour	To mitigate rear-end and SB LT crashes	-	-	-	-	-																			0	0	0	28
Timberline & Custer	-	Intersection Improvements	Operational	Signing and Marking: Provide additional signing and marking to deconflict right-turns w/bicyclists		-	-	-	-	-																			0	0	0	28

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Timberline & Drake	-	Intersection Improvements	Operational	Signal Modification: Add EB and WB RT overlap signals/phases	Improves AM approach LOS from LOS E/F (EB/WB) to LOS D/D and overall LOS from D to C in AM peak	-	-	-	-	-																			0	0	0	28
College Avenue Corridor Improvements	Olive to Cherry	Corridor Improvements	Study	Planning Project: Safety improvements through downtown (TBD), include Cherry Ave		-	-	-	-	-																			0	0	0	28
Harmony Corridor	Boardwalk to Mason	Corridor Improvements	Study	Corridor Study: to review access control, safety and multimodal improvements		-	-	-	-	-																			0	0	0	28
Mountain Avenue Corridor Improvements	Mason to Jefferson	Corridor Improvements	Study	Roadway and multimodal Improvements being planned as separate project	In Progress	-	-	-	-	-																			0	0	0	28

Appendix D
Crash & Safety Analysis

Table of Contents

Peak Hour Delay Reduction for Capital Projects w/ Capacity Improvements
Crash Reduction Calculations

Transportation Capital Project Proritization Study

8/16/2022

Peak Hour Delay Reduction for Capital Projects w/Capacity Improvements

Intersection ID	Intersection	Peak Hour Delay Reduction (Average of All Peak Hours)	AM Peak Hour												Midday Peak Hour												PM Peak Hour											
			Overall LOS and v/c			Approach LOS									Overall LOS and v/c			Approach LOS									Overall LOS and v/c			Approach LOS								
						1		2		3		4						1		2		3		4						1		2		3		4			
			Delay(s)	LOS	v/c	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS		Delay(s)	LOS	v/c	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS		Delay(s)	LOS	v/c	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	Delay(s)	LOS	
5	College (US 287) & Drake		37.8	**D**	0.74	27.8	C	67.3	E	32.1	C	27.7	C		36.0	**D**	0.71	97.1	F	45.2	D	20.4	C	15.4	B		60.3	**E**	0.98	59.2	E	86.7	F	61.0	E	48.0	D	
	w/Improvements	**-8.4**	30.9	**C**	0.72	26.2	C	43.8	D	32.4	C	20.9	C		28.4	**C**	0.69	55.8	E	47.2	D	19.7	B	14.2	B		49.6	**D**	0.93	57.2	E	70.1	E	57.8	E	30.2	C	
	Peak Hour Delay Reduction		***-6.9***			*-1.6*		*-23.5*		*0.3*		*-6.8*			***-7.6***			*-41.3*		*2.0*		*-0.7*		*-1.2*			***-10.7***			*-2.0*		*-16.6*		*-3.2*		*-17.8*		
47	Shields & Prospect		33.3	**C**	0.75	45.0	D	50.6	D	25.8	C	17.5	B		24.5	**C**	0.56	43.3	D	48.1	D	9.2	A	7.8	A		53.2	**D**	0.94	45.8	D	109.3	F	29.4	C	28.7	C	
	w/Improvements	**-5.1**	33.4	**C**	0.74	44.8	D	52.1	D	25.8	C	17.5	B		25.7	**C**	0.51	47.5	D	53.5	D	7.3	A	6.3	A		36.7	**D**	0.85	45.8	D	49.0	D	28.4	C	27.9	C	
	Peak Hour Delay Reduction		***0.1***			*-0.2*		*1.5*		*0.0*		*0.0*			***1.2***			*4.2*		*5.4*		*-1.9*		*-1.5*			***-16.5***			*0.0*		*-60.3*		*-1.0*		*-0.8*		
64	Lemay & Drake		39.8	**D**	0.87	46.1	D	64.7	E	27.0	C	17.9	B		36.9	**D**	0.76	43.9	D	57.5	E	29.0	C	20.9	C		56.9	**E**	1.02	95.4	F	67.0	E	35.2	D	35.0	C	
	w/Improvements	**-6.0**	36.3	**D**	0.87	45.9	D	53.0	D	26.9	C	16.7	B		35.5	**D**	0.68	43.9	D	51.8	D	28.8	C	20.6	C		43.9	**D**	0.92	37.7	D	49.1	D	50.4	D	40.5	D	
	Peak Hour Delay Reduction		***-3.5***			*-0.2*		*-11.7*		*-0.1*		*-1.2*			***-1.4***			*0.0*		*-5.7*		*-0.2*		*-0.3*			***-13.0***			*-57.7*		*-17.9*		*15.2*		*5.5*		
94	Timberline & Prospect		37.3	**D**	0.76	48.3	D	24.3	C	31.3	C	48.4	D		36.2	**D**	0.69	51.7	D	26.4	C	27.1	C	40.5	D		49.9	**D**	0.89	35.8	D	35.0	C	65.5	E	73.3	E	
	w/Improvements	**-2.0**	35.8	**D**	0.70	43.8	D	23.3	C	32.8	C	15.7	B		35.3	**D**	0.64	47.6	D	25.7	C	29.3	C	38.5	D		46.4	**D**	0.83	33.6	C	34.0	C	63.7	E	59.7	E	
	Peak Hour Delay Reduction		***-1.5***			*-4.5*		*-1.0*		*1.5*		*-32.7*			***-0.9***			*-4.1*		*-0.7*		*2.2*		*-2.0*			***-3.5***			*-2.2*		*-1.0*		*-1.8*		*-13.6*		
95	Timberline & Horsetooth		44.1	**D**	0.84	44.0	D	46.8	D	32.0	C	56.2	E		35.3	**D**	0.61	35.0	C	39.4	D	21.4	C	48.0	D		38.1	**D**	0.81	49.6	D	57.6	E	26.8	C	29.4	C	
	w/Improvements	**-2.7**	40.9	**D**	0.71	44.0	D	46.8	D	24.5	C	53.1	D		34.0	**C**	0.53	35.0	C	39.4	D	19.2	B	45.8	D		34.5	**C**	0.7	39.2	D	50.0	D	27.2	C	29.6	C	
	Peak Hour Delay Reduction		***-3.2***			*0.0*		*0.0*		*-7.5*		*-3.1*			***-1.3***			*0.0*		*0.0*		*-2.2*		*-2.2*			***-3.6***			*-10.4*		*-7.6*		*0.4*		*0.2*		
97	Timberline & Harmony		42.9	**D**	1.00	28.5	C	41.3	D	57.6	E	49.4	D		34.9	**C**	0.8	30.2	C	25.5	C	46.3	D	50.2	D		53.0	**D**	1.01	38.1	D	25.9	C	69.7	E	98.6	F	
	w/Improvements	**-6.9**	37.7	**D**	0.91	24.4	C	35.3	D	46.1	D	50.9	D		33.2	**C**	0.75	26.7	C	23.7	C	45.7	D	50.6	D		39.2	**D**	0.93	34.9	C	24.4	C	50.0	D	56.8	E	
	Peak Hour Delay Reduction		***-5.2***			*-4.1*		*-6.0*		*-11.5*		*1.5*			***-1.7***			*-3.5*		*-1.8*		*-0.6*		*0.4*			***-13.8***			*-3.2*		*-1.5*		*-19.7*		*-41.8*		
101	Shields & Horsetooth		28.3	**C**	0.84	47.0	D	45.9	D	16.8	B	21.0	C		21.6	**C**	0.58	43.8	D	39.2	D	10.1	B	11.0	B		32.6	**C**	0.87	43.1	D	43.3	D	25.5	C	27.8	C	
	w/Improvements	**2.2**	30.0	**C**	0.88	46.5	D	30.2	C	19.3	B	30.4	C		25.1	**C**	0.6	43.8	D	31.5	C	16.6	B	20.1	C		34.0	**C**	0.9	50.0	D	45.3	D	25.8	C	27.4	C	
	Peak Hour Delay Reduction		***1.7***			*-0.5*		*-15.7*		*2.5*		*9.4*			***3.5***			*0.0*		*-7.7*		*6.5*		*9.1*			***1.4***			*6.9*		*2.0*		*0.3*		*-0.4*		
109	Hogan/JFK & Harmony		12.7	**B**	0.55	7.8	A	10.6	B	51.5	D	48.2	D		11.1	**B**	0.49	6.3	A	7.9	A	57.2	E	50.6	D		37.5	**D**	0.87	18.5	B	22.3	C	56.4	E	102.0	F	
	w/Improvements	**-6.7**	9.6	**A**	0.53	4.6	A	8.2	A	51.9	D	41.3	D		10.0	**A**	0.48	6.2	A	6.8	A	57.5	E	44.9	D		21.7	**C**	0.85	17.0	B	7.3	A	55.9	E	57.4	E	
	Peak Hour Delay Reduction		***-3.1***			*-3.2*		*-2.4*		*0.4*		*-6.9*			***-1.1***			*-0.1*		*-1.1*		*0.3*		*-5.7*			***-15.8***			*-1.5*		*-15.0*		*-0.5*		*-44.6*		
150	Prospect & Summit View (Prospect Corridor from Sharp Point to I-25)		9.5	**A**	0.82	1.3	A	12.3	B	30.0	C	30.0	C		6.6	**A**	0.46	5.9	A	3.4	A	44.2	D	44.2	D		5.4	**A**	0.63	5.5	A	4.7	A	53.8	D	11.9	B	
	w/Improvements	**-4.2**	3.6	**A**	0.44	0.3	A	2.9	A	30.0	C	30.0	C		3.8	**A**	0.25	1.5	A	1.9	A	44.2	D	44.2	D		1.5	**A**	0.33	0.5	A	1.9	A	53.8	D	11.9	B	
	Peak Hour Delay Reduction		***-5.9***			*-1.0*		*-9.4*		*0.0*		*0.0*			***-2.8***			*-4.4*		*-1.5*		*0.0*		*0.0*			***-3.9***			*-5.0*		*-2.8*		*0.0*		*0.0*		
169	Timberline & Carpenter		31.6	**C**	0.92	21.2	C	33.2	C	42.4	D	34.9	C		15.5	**B**	0.55	11.4	B	18.4	B	21.2	C	13.9	B		29.9	**C**	0.86	23.5	C	32.1	C	37.3	D	28.7	C	
	w/Improvements	**-1.5**	30.3	**C**	0.92	21.2	C	28.4	C	42.4	D	34.9	C		14.2	**B**	0.55	11.4	B	14.1	B	21.2	C	13.9	B		27.9	**C**	0.86	23.5	C	26.9	C	37.3	D	28.7	C	
	Peak Hour Delay Reduction		***-1.3***			*0.0*		*-4.8*		*0.0*		*0.0*			***-1.3***			*0.0*		*-4.3*		*0.0*		*0.0*			***-2.0***			*0.0*		*-5.2*		*0.0*		*0.0*		

Crash Reduction Calculations

Project	Segment	Safety Improvement	CMF	# Total Applicable Crashes[1]	# Reduced Crashes	Notes	CMF Countermeasure
Lemay & Drake	n/a	Straighten EB approach curve	0.92	0	0.0	No crashes potentially attributable to existing curve identified	"Change horizontal curve radius from X to Y (feet)" (WANG ET AL., 2018)
		Access control S leg	0.77	25	5.8		"Replace TWLTL with raised median" (MAUGA AND KASEKO, 2010)
		Access control Edinburgh	--	7	7.0	7 left-turn crashes that would have been eliminated	
				Total	**12.8**		
Shields & Prospect	n/a	Add WB right-turn decel lane w/overlap signal	0.7	18	5.0	Apply to WB rear end crashes	"Install right-turn lane" (ALE ET AL., 2014)
		Consider SB protected-only LT operation	0.01	20	20	Apply to SB left-turn right-angle crashes; *consider added delay/queue w/protected-only*	"Change from permitted or permitted-protected to protected" (HARKLEY ET AL., 2008)
				Total	**25.0**		
Shields & Horsetooth	n/a	Extend SB LT storage, protected-only SB LT	0.01	22	22	Apply to SB left-turn right-angle crashes; consider added delay/queue w/protected-only	"Change from permitted or permitted-protected to protected" (HARKLEY ET AL., 2008)
		Restrct left-turns w/ median at Richmond/Shields	n/a	12	12	Apply to side-street (6) and main-street (6) left-turn crashes; *consider access impacts*	"Change from permitted or permitted-protected to protected" (HARKLEY ET AL., 2008)
				Total	**34.0**		
Boardwalk & Harmony	n/a	Improve NB signal head alignment	0.79	18	3.8	Apply to NB rear-end crashes	"Improve Signal Visibility" (EL-BASYOUNY AND SAYED, 2011)
		Add LT side-of-pole heads	n/a	0.0	0.0		None
		Upgrade NB & SB LT to FYA	0.838	28	4.5	Apply to NB/SB apporach turn crashes	"Change from 5-section "doghouse" protected/permissive left turn to flashing yellow arrow protected/permissive left turn" (SIMPSON AND TROY, 2015)
				Total	**8.3**		
Overland & Elizabeth	n/a	Convert from side-street stop control to roundabout	0.28	25	**18.0**	Apply to all crashes	"Conversion of stop-controlled intersection into single-lane roundabout" (PERSAUD ET AL., 2001)
Shields & Plum	n/a	Protected intersection	n/a	7	**7.0**	Reduce by bike & ped crashes	None
Heatheridge & Prospect	n/a	Replace existing HAWK with full, three-leg traffic signal	n/a	5	5.0	Reduce by side-street turn crashes	None
		Consider raised median/ped refuge on west leg	n/a	0	0	No ped crashes, no reduction	None
				Total	**5.0**		
Timberline & Carpenter	n/a	Extend WB right-turn decel lane	0.93	24	1.7	Existing 250' total length; increase to ≥ 500' total length (CDOT)	"Extend deceleration lane by approx. 100 ft" (closest CMF has); (ELVIK, R. AND VAA, T., 2004); apply to WB approach crashes (right and through)
		Extend EB left-turn decel lane	0.93	41	2.9	Existing 155' total length; assume min. increase to CDOT Access Code 435' per 45 mph	"Extend deceleration lane by approx. 100 ft" (closest CMF has); (ELVIK, R. AND VAA, T., 2004); apply to EB approach crashes (left and through)
				Total	**4.6**		
Prospect Corridor	Sharp Point to I-25	Widen to 5-lane cross-section	0.76	18	**4.3**	Apply to all crashes (Prospect/Summitview)	"Install an additional lane" (DIXON ET AL, 2016)
Taft Hill Corridor Improvements	LC Landfill to Fromme Prairie	Add shoulders/widen existing shoulders	0.771	39	8.9	Assume widen 4' to 10' on average	"Widen shoulder" (PARK ET AL., 2014); apply to all crashes
		Improve animal crossing/warning signage	0.65	11	7.0	Apply to any animal crossing crashes	"Install advance warning signs (positive guidance)" (POLANIS, 1999)
				Total	**15.9**		
Drake Road Diet	Overland Trail to Taft	Road Diet	0.53	28	**13.2**	Apply to all crashes on Drake	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)
JFK Road Diet	Harmony to Horsetooth	Road Diet	0.53	60	**28.2**	Apply to all crashes on JFK	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)
Riverside Avenue Road Diet	Lemay to Prospect	Road Diet	0.53	44	**20.7**	Apply to all crashes on Riverside	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)
Troutman Corridor Improvements	Mason to Boardwalk	Road Diet	0.53	40	**18.8**	Apply to all crashes on Troutman	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)
Shields Road Diet	Mulberry to Mountain	Road Diet	0.53	6	**2.8**	Apply to all crashes on Shields	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)
Ziegler Road Diet	Rock Creek to Harmony	Road Diet	0.53	7	**3.29**	Apply to all crashes on Ziegler	"Converting four-lane roadways to three-lane roadways with center turn lane (road diet)" (PERSAUD ET. AL, 2010)

(1) Applicable crashes from Jan 2015 to Aug 2020

Appendix E
Conceptual Designs

NOTE: THIS SECTION IS IN DEVELOPMENT

Appendix F
Environmental Summary

Table of Contents

Initial Environmental Desktop Review

Table E1 - Initial Environmental Desktop Review

Project Name/Location	Project Type	Threatened & Endangered Wildlife, State Listed Wildlife	Raptor Nest Boundary	Potentail EDR	Wetlands/Waters of the US Impacts	WOTUS Jurisdiction	Floodplain Impacts	Protected Areas (Section 4f Non-historic)	Field Visit	Substantial New Surface Impacts
Suniga Road	New Construction	Yes	Yes	Yes	Yes	All features likely jurisdictional	Range of FEMA Floodplain: 0.2 Percent Annual Chance Flood Hazard; Area of Minimal Flood Hazard; Within Floodway	No	Yes	Yes
Prospect Corridor Improvements	Corridor Improvements	Yes	Yes	Yes	Yes	All features likely jurisdictional	Range of FEMA Floodplain: 0.2 Percent Annual Chance Flood Hazard; Area of Minimal Flood Hazard; Within Floodway	Yes	Yes	Yes
Taft Hill Corridor Improvements	Corridor Improvements	Yes	No	Yes	Yes	All features likely jurisdictional	Area of Minimal Flood Hazard	Yes	Yes	Yes
Timberline & Prospect	Intersection Improvements	Yes	No	Yes	Yes	All features likely jurisdictional	Range of FEMA Floodplain: Area of Minimal Flood Hazard; Area With Reduced Flood Risk Due To Levee; Within Floodway	No	Yes	Yes
Timberline Road North - Segment 1	New Construction	No	Yes	Yes	Yes	All features likely jurisdictional	Range of FEMA Floodplain: Area of Minimal Flood Hazard; 0.2 Percent Annual Chance Flood Hazard; Within Floodway	No	Yes	Yes
Timberline Road North - Segment 2	New Construction	No	Yes	Yes	Yes	All features likely jurisdictional	Area of Minimal Flood Hazard	No	Yes	Yes
Timberline & Harmony	Intersection Improvements	No	No	Yes	Yes	All features likely jurisdictional	Area of Minimal Flood Hazard	No	Yes	No
Riverside Avenue Road Diet	Road Diet	Yes	No	Yes	Yes	Likely jurisdictional depending on confirmartion of Project boundary	Area of Minimal Flood Hazard	Yes	Yes	No
Timberline & Carpenter	Intersection Improvements	Yes	Yes	No	No	NA	Area of Minimal Flood Hazard	Yes	Yes	Yes
Vine Drive & Timberline Road Overpass	New Construction	No	Yes	Yes	No	NA	Area of Minimal Flood Hazard	No	Yes	Yes
Boardwalk & Harmony	Intersection Improvements	No	No	No	No	NA	Area of Minimal Flood Hazard	No	No	No
Harmony & JFK/Hogan	Intersection Improvements	No	No	No	No	NA	Area of Minimal Flood Hazard	No	No	No
Shields & Horsetooth	Intersection Improvements	No	No	No	No	NA	Area of Minimal Flood Hazard	No	No	No
Shields & Prospect	Intersection Improvements	No	No	No	No	NA	Area of Minimal Flood Hazard	No	No	No